Officials report on successful radar mapping mission

Processing and analysis of the data from last February's Shuttle Radar Topography Mission will take about another two years, officials from NASA's Jet Propulsion Laboratory reported during a program held May 17 at the Johnson Space Center's Teague Auditorium.

SRTM Chief Scientist Dr. Michael Kobrick and SRTM Chief Engineer Ed Caro discussed the 11-day flight during the STS-99 mission aboard *Endeavour*, including the flight's highlights, results to date, lessons learned for future flights, and the overall importance of the mission.

NASA JSC Photo 2000e01556

Two radar images were bounced off the Earth's surface simultaneously during STS-99, one by the same C-band and X-band antennas used to take radar images from the shuttle's payload bay on STS-59 and STS-68 and another similar antenna at the end of a 60-meter mast.

Kobrick reported that the mission was an outstanding success. "Everything worked nearly perfectly. We have made backup copies of all 330 data tapes, and the quality of the data appears to be fabulous."

The SRTM payload consisted of three main sections: radar electronics and antennas located in the payload bay; a mast that deployed to 200 feet once in space (the largest rigid structure ever flown in space); and outboard antennas attached to the end of the mast. The SRTM acquired enough data during the 10 days of operation to compile what will be the most complete, near-global, high-resolution topographic map of the Earth ever made.

The Spaceborne Imaging Radar-C (SIR-C) and X-band Synthetic Aperture Radar (X-SAR), which flew twice on the space shuttle in 1994 during the STS-59 and STS-68 Space Radar Laboratory missions, comprised the heart of the SRTM radar. But several modifications were made, which gave the SRTM system new capabilities compared with SIR-C/X-SAR. The major change was the addition of C-band and X-band antennas at the end of the mast. These secondary, or "outboard," antennas allowed the radar to use a technique called interferometry to map the elevation of the terrain in a single pass, which was not possible with SIR-C/X-SAR.

Interferometry can be likened to a person dropping two pebbles into a puddle of water and watching the ripples, or concentric circular waves emanating outward from the splash, meet and interfere with each other. In a radar interferometer, the interference patterns were generated with microwaves, which were then measured by the radar systems on board the shuttle to acquire topographic data. The main antenna on the shuttle bounced radar pulses off the Earth, and the "backscattered," or reflected, radar echoes were recorded by both antennas simultaneously.

The design of the SRTM mission was also different from SIR-C/X-SAR. Instead of focusing on a limited number of "supersite" targets for repeated viewing, as was done with SIR-C/X-SAR, SRTM was designed to map as much of the land surface as possible. SIR-C/X-SAR covered only a few percent of the Earth's land area.

During the mission, *Endeavour*'s radar systems mapped more than 47.6 million square miles of the area between 60 degrees north latitude and 56 degrees south latitude at least once. This represents 99.96 percent of the planned mapping area. About 94.6 percent of it was covered twice and almost half was covered three or more times. Only about 80,000 square miles in scattered areas remained unimaged, most of them in North America and Asia and most already well mapped by other methods.

For various parts of the world, maps of Earth's topography are limited, inaccurate, or nonexistent. For example, many mountain chains, inhospitable deserts, and dense tropical forests have topographic coverage that is totally inaccurate, mainly because of the difficulty in getting to these locations and the near-constant cloud cover. Even where topographic maps exist they may have been created in such a way as to limit their usefulness. For example, neighboring countries may generate topographic data using entirely different methods. This lack of standardization effectively limits the scope of regional or global studies where precise topography is important.

According to Kobrick, two years will be needed to process SRTM data because there is so much of it and because extreme care will have to be taken in processing it to meet mapping accuracy standards. All of the data have to be combined into a comprehensive mosaic. "Nobody has taken data like this and made a global map," Kobrick said.

Kobrick noted that SRTM data would find applications in many fields including communications (placement of communication towers) and air traffic safety (development of enhanced ground proximity warning systems). ■

For the latest on results from the mission, visit Web site www.jpl.nasa.gov/srtm/

Mission in-flight anomalies:

- Cold gas thruster failure. The thruster operated for 18 hours and then stopped. The failure was traced to a ruptured burst disk.
- Damper failure. The failure was traced to a missed step in manufacturing – and the manufacturer did not account for possible material shrinkage over time.
- Mast stalling at end of retraction sequence. The anomaly was attributed to the fact that the cables got very cold after 10 days in space and became less flexible.

Lessons learned from the SRTM:

- Flight safety is foremost. Involve the safety panel at JSC early in the program. Safety is paramount, especially when human lives are at stake.
- Don't neglect the simple things. Complex systems get a lot of attention, which usually leads to uncovering potential problems. Simple things attract less scrutiny but can potentially bring the whole system down.
- Conservative design pays off. The structural margin in the mast allowed for increased stability.
- Margin is important. Additional propellant helped complete the mission.
- Training and mission simulations are valuable. Simulations were crucial to developing the level of proficiency needed to conduct the complex mission. Very little data were lost during the mission. None of the loss can be attributed to spacecraft problems or crew error.
- Teamwork is important.
- Do not use the formal review process to address problems for the first time.

Super Guppy Shipping Fixture has new home

The JSC Center Operations Directorate, Logistics Division, Transportation Branch, took user-possession of Bldg. 924, the Super Guppy Shipping Fixture Storage Building, on May 3. On that date, the SGSF was transported to Bldg. 924 and placed inside for the first time.

The new SGSF storage building is located behind the Sonny Carter Training Facility. This location provides for easy access to the Ellington Field flight line where the fixture is on/off-loaded on the Super Guppy aircraft. The facility was built as a design/build project in conjunction with the Neutral Buoyancy Laboratory Mockup Storage Building and laydown area.

Building 924 is a 40-foot by 125-foot metal building with two 6-ton bridge cranes having a hook height of 35 feet. The building was designed to provide a secure and controlled environment specifically to house the SGSF and to be able to remove the SGSF Environmental Control System top and end covers and store them separately in the building.

NASA JSC Photo 2000-03863

Building 924 behind the Sonny Carter Training Facility is the new home for the Super Guppy Shipping Fixture.

The SGSF is used to transport International Space Station hardware from manufacturing locations to both test and launch sites. The SGSF had previously been stored temporarily in the NBL and Light Manufacturing Facility areas of the SCTF. The protection of the SGSF is of great importance to NASA's International Space Station Program.

The other facilities built on this project consist of a 20,000-square-foot NBL mockup storage building (Building 925) and a 25,000-square-foot concrete laydown area. These areas were needed to house the expanding number of mockups used in the NBL and to free up high-bay space in the NBL and LMF for mockup outfitting and development.

Bobby Boyd of the Logistics Division, Transportation Branch, said, "We are elated to have a home for the Super Guppy Shipping Fixture. We would like to give a special thanks to Project Manager William Roeh and the entire Center Operations Directorate Project Management Office for their excellent work in getting both buildings 924 and 925 built and ready for occupancy in such a short time."

Design/build construction was chosen by the Center Operations Directorate's Project Management Office as a means to construct these facilities on a fast-track basis. The primary fast-track driver was the need for mockup storage. A contract with Barnier Building Systems was signed on August 27, 1999. Approval of the installation had to be obtained from the Federal Aviation Administration, Houston Airport System, and the City of Houston.

Excellent weather conditions during the site preparation phase allowed the mockup laydown area to be completed ahead of schedule. Occupancy of this area was taken on January 13, 2000. ■